GARLIC REVISITED: THERAPEUTIC FOR THE MAJOR DISEASES OF OUR TIMES?

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Garlic may play an invaluable role in the prevention and therapy of the major causes of death. Anecdotal, basic, and clinical research data are confirming the efficacy of this herb in the treatment of hyperlipemia, cancer, heavy-metal intoxication, infectious diseases, hypertension, free-radical damage, and immune deficiency states. Garlic's broad antimicrobial spectra and its ability to modulate immunity may play a strategic role in the acquired immunodeficiency syndrome pandemic. A review of the literature supports a greater scrutiny of this herb's therapeutic potential.

Tremendous anecdotal evidence supports the invaluable role that garlic has played in the therapy of many diseases since time immemorial.[1,2] Increasingly, this role is being confirmed by basic and clinical research reports from around the world.[3-9] Garlic is the best example of the philosophy that your medicine should be your food, and your food should be your medicine. Some diseases that have been treated successfully with garlic include thromboembolic disorders, hypertension, hyperlipemia, heavy-metal toxicity, and various infections—some of the major killers of our times.

Garlic has been a mainstay in the medicinal arsenal of many past civilizations, including the Egyptian, Hebrew, Chinese, Greek, Indian, Japanese, and Roman.[1,2,9,10] French priests consumed liberal quantities of garlic during the bubonic plague and had a much higher survival rate than their English counterparts. During the World Wars, Britain, Germany, and Russia used garlic for treating battlefield infections with much success.[1,11-13] Because of preliminary data that strongly support it as an immune enhancer, and because of its effectiveness against a number of opportunistic microbes that are associated with acquired immunodeficiency syndrome (AIDS), including Herpesvirus hominis type I,[8] cryptococcal,[14,15] mycobacterial,[16,17] and candidal[18] organisms, garlic may have a strategic role to play in the AIDS pandemic. No other substance, either natural or synthetic, can match garlic's proven therapeutic versatility and effectiveness.

The pharmacologic effect of garlic is based on its activity as a hypoglycemic and hypolipemic agent,[19-39] anticoagulant,[40-54] antihypertensive,[55,56] antimicrobial,[57-69] detoxifier of heavy metals,[1] and an immune-system modulator.[70] Further basic and clinical studies need to be directed toward the pharmacology of garlic and how it relates to the quality of various preparations. This is necessary for determining the routes of administration, dosages, amounts, and efficacy of this herb.

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TABLE 1. CONTENTS OF AMINO ACIDS AND RELATIVE VALUE OF GARLIC

Amino Acids	Content (mg/mL)	Relative Value (%)
Lysine*	0.95	4.4
Histidine	0.32	1.5
Arginine	6.55	30.3
Aspartic acid	2.10	9.7
Threonine*	0.58	2.7
Serine	0.63	2.9
Glutamine	4.50	20.8
Proline	0.80	3.7
Glycine	0.69	3.2
Alanine	0.70	3.2
Cysteine	0.36	1.7
Valine*	0.82	3.8
Methionine*	0.12	0.6
Isoleucine*	0.43	2.0
Leucine*	0.81	3.7
Tryptophan*	0.60	2.8
Phenylalanine*	0.66	3.0
Total	21.62	100

* Essential amino acids

Evidence to date indicates that raw or cold-aged, whole-clove garlic offers the greatest medicinal value. Much of the therapeutic composition of garlic is lost when preparing it with heat. Cold-aged, whole-clove garlic preparations are odorless, predigested, and retain the same balance, quality, and quantity of medicinal factors as the raw. The highest quality garlic is grown organically in germanium- and selenium-rich unpolluted soil.

Revisiting garlic means exploring a new frontier of vast therapeutic potential. This potential has application for curing and preventing the major scourges of our times.

DISCUSSION

The chemistry of garlic, *Allium sativum,* establishes it as a member of the lily family. Block et al[4] have elucidated some of the chemical compounds in garlic and have made correlations with their pharmacologic activity.

Garlic contains 33 sulfur compounds, 17 amino acids (including all of the essential ones), germanium, calcium, copper, iron, potassium, magnesium, selenium, zinc, and vitamins A, B_1, and C.[9] Future studies may reveal other therapeutic components (Tables 1 and 2).

TABLE 2. THE MEDICINAL SPECTRA OF GARLIC

Pharmacologic Activity	Probable Components Contributing to Activity
Anticoagulation	Ajoene
Antihypertensive	Selenium, germanium
Antimicrobial	
Antiparasitic	Allicin-alliin
Antibiotic	Allicin-alliin
Antimycotic	Allicin-alliin, ajoene
Antiviral	Allicin-ajoene
Hypolipemic	Diallyl disulfide
Detoxification of heavy metals	Selenium, allyl mercaptan germanium
Antitumor	Selenium, germanium
Vitamins	Thiamine, vitamins A and C
Antioxidant	Selenium, germanium
Antiaging	Selenium, diallyl disulfide
Immune modulation	
Natural killer-cell activity and other kinds of cell-mediated immunity	Germanium, selenium zinc*
Humoral immunity	Germanium, allicin
Complement activity	Magnesium, calcium

* Zinc is essential for the synthesis of the thymus gland hormone, thymosin.

MEDICINAL EFFECTS

Hypolipemic Activity

Human and animal studies have substantiated that garlic lowers serum cholesterol and triglycerides and increases the amount of high-density lipoproteins (HDL).[19-39] Dietary-induced atherosclerosis was significantly reversed in rabbits when fed garlic consistently for a few weeks. The hypolipemic activity of garlic may be partially responsible for the enhanced natural killer-cell activity noted in preliminary studies. The incidence of major diseases associated with hyperlipemia, such as cancer, diabetes mellitus, and thromboembolic disorders, could be reduced with regular consumption of garlic. Hyperlipemia is the underlying pathophysiology of the number one killer, atherosclerotic coronary artery heart disease.

Anticoagulation

This effect complements the hypolipemic activity of garlic and further solidifies a role for this herb in the prevention and therapy of atherosclerotic coronary artery heart disease.[71-78] Platelet aggregation su-

perimposed on an atherosclerotic vessel is a major antecedent event causing myocardial injury, infarction, and thromboembolic diseases. Studies have shown that garlic has great potential in inhibiting platelet aggregation and enhancing fibrinolytic activity.

Antihypertension

Anecdotally, Afro-Americans in the rural South have used garlic to prevent and treat hypertension since the days of slavery. Garlic may have the capacity to be used alone or to supplement allopathic medicines used in current therapy that have side effects, such as impotence and tolerance. Studies suggest that garlic may exert its ability to lower blood pressure by acting like prostaglandin E_1, which decreases peripheral vascular resistance.[79]

Nutritional Supplement

The nutritional composition of garlic includes magnesium, iron, copper, zinc, selenium, calcium, potassium chloride, germanium, sulfur compounds, amino acids, vitamins A, B_1, and C. Thiamine (B_1) is well known for its role in the therapy of malnutrition. The adverse effect of malnutrition on the immune system has been established. Garlic increases the body's capacity to assimilate thiamine by enhancing its absorption. Thiamine is a key part of the cocarboxylase enzyme that acts beneficially on liver cells, and this may help to explain claims that garlic is prophylactic for liver and gallbladder damage.[9] Garlic protects hepatocytes in tissue culture from the damage of carbon tetrachloride.[7] Along with selenium, vitamin C and zinc contribute to the antioxidant capacity of garlic. Garlic is one of the richest sources of organic germanium and selenium, and studies have shown great potential in germanium for enhancing the immune system. This mechanism could help explain how garlic has enhanced natural killer-cell activity.[80–82] The functional role that the amino acids, especially the essential ones, play in maintaining our physiologic well-being are numerous (Table 1). However, garlic consumption does have side effects, including dermatitis,[83–85] most often caused by an allergic response to the high sulfur content, and colitis, caused by an overkill of normal flora in the gut. This is usually caused by overconsumption of raw garlic.

Detoxification

Garlic has been shown to be effective in the treatment of lead, mercury, cadmium, and arsenic poisoning. Some sulfur compounds bind heavy metals and other exogenous toxins such as food additives[86]; these additives include undesirable dyes, preservatives, and sweeteners. This binding facilitates excretion. Garlic is the richest source of organically bound selenium, which has been shown to provide some protection against heavy-metal toxicity.

Antioxidant Activity

The free-radical scavenger action of garlic can probably be explained by its germanium, glutathione, selenium, and zinc content. The latter three are key components of the antioxidant enzymes, superoxide dismutase and glutathione peroxidase. Free-radical pathology has been incriminated in an array of degenerative disorders, which include aging, arthritis, and cancer. One mechanism of aging is thought to be secondary to the lipid microviscosity of cell membranes.[87] Garlic may have great potential for retarding aging because it inhibits lipogenesis. Garlic may play an adjunctive role in oncology therapy by neutralizing the free-radical damage to normal tissues caused by radiation and chemotherapy.[88] In addition to its role as an antioxidant, germanium activates or substitutes for oxygen, which may be the most powerful stimulant of the immune system.

Immune System Modulation

Garlic may be a potent, nonspecific biologic response modifier. This was dramatically shown in mice implanted with transitional-cell carcinoma that were treated by intralesional and systemic administration of garlic.[6] The reduction and destruction of tumor mass were proportional to the dosage and length of administration. Microscopically, garlic enhanced macrophage activity and cytotoxic T-cell necrosis in these tumors regardless of intralesional or systemic administration. The phagocytic activity of peritoneal macrophages has been enhanced in rats when garlic was administered.[89]

Preliminary studies have shown that humans fed garlic and cold-aged, whole-clove preparations daily for three weeks had natural killer (NK) cells that destroyed 140 to 160 percent more K562 lymphoma cells than controls in vitro. These findings suggest

that garlic may have an effect on other components of cell-mediated immunity, including macrophages and T cells. Increased NK-cell activity may represent increased lymphokine production.[90] Interleukin II and the gamma interferons are two lymphokines that increase NK-cell activity. Garlic may enhance the production of other lymphokines, such as the tumor necrosis factor, which may account for the impressive destruction of tumors in laboratory animals.[6] Enhanced NK-cell activity may also be secondary to garlic affecting the synthesis and release of natural killer cytotoxic factors (NKCF), including cytolysin.[91] These factors are released by NK cells to destroy cancer and virus-infected cells. The NKCF content of the NK cells in AIDS patients is markedly reduced and NKCF production is inhibited.[91] Studies of garlic and immunity should yield invaluable basic research and clinical data to help us better understand how this herb may aid in the prophylaxis of invasion by microbes and subversion by cancer. Evidence to date suggests that garlic may become known as one of the grand conductors of the body's immune symphony. The capacity of garlic to modulate immunity is exemplified by some of its contents (Table 2).

Anticancer Potential

The anticancer activity of garlic may be explained by a synergism of the pharmacologic effects mentioned previously. Garlic has had a direct cytotoxic effect on some cancer cells, including two lines of gastric cancer cells.[92] Incubation of Erlich's ascites carcinoma, sarcoma-180, and Morris hepatoma cells with garlic prevented peritoneal implantation in laboratory animals.[93–95] Repeat implantation of cancer cells that were incubated in garlic prior to injection triggered the humoral immune system and protected laboratory animals from challenges with untreated cancer cells. Garlic may alter the membranes of these tumor cells, making them antigenic with antibody production, while boosting cell-mediated immunity. It may also unmask or alter receptors in the cell wall of tumor cells that are responsible for the escape of cancer from NK cells, cytotoxic T cells, and macrophages. Residents of a region in China who did not eat garlic had 1,000 times more stomach cancer than those in a region who consumed large quantities of garlic regularly.[89]

Selenium and sulfur are two other factors that are probably responsible for some of the cancer-preventing activity of garlic. These elements assist in antioxidation, carcinogen excretion, and immune-system modulation. Nitrates and nitrites have been incriminated as causes of gastric cancer.[86] Garlic offers protection against these carcinogens.[96] Garlic's role as an immune-system modulator and biologic-response modifier is indicated by the enhancement of NK-cell activity, macrophages, and cytotoxic T-cell activity. This herb may make an enormous contribution to the therapy of cancer and AIDS.[96] Allicin, a component of garlic, is thought to retard tumor growth by inhibiting sulfhydryl enzymes.[98,99]

Antimicrobial Spectra

The amazing pharmacologic versatility of garlic is best reflected by its antiviral, antifungal, antiprotozoan, antiparasitic, and antibacterial activity.[57–68,100–108] Allicin and other sulfur compounds are thought to be the major antimicrobial factors in garlic. Recent studies have shown that ajoene, the factor responsible for anticoagulation in garlic, was superior to allicin in antifungal activity against Candida albicans and Aspergillus niger.[108]

Garlic is effective against a number of gram-negative, gram-positive, and acid-fast bacteria, including Staphylococcus, Salmonella, Vibrio, Mycobacteria, and Proteus species.[12] Recurrent pyogenic, salmonellal, and mycobacterial infections are seen frequently in AIDS.

Some of the fungi that are susceptible to garlic include Coccidioides, Aspergillus, Histoplasma, Trichophyton, Candida, and Cryptoccocci. Cryptococcal meningitis has been treated successfully in China with garlic. It is the number one cause of death in the pediatric AIDS patients of Africa. Any effective therapy for AIDS must penetrate the blood-brain barrier to inhibit or destroy the human immunodeficiency virus (HIV) and other associated opportunistic microbes that cause serious central nervous system pathology. The brain is an important reservior for HIV, and dementia is a significant morbid feature of AIDS. The most common fungal infection of adult AIDS patients in America is candidiasis of the mouth, throat, and esophagus. Candidal organisms are very sensitive to garlic.

Garlic was used by Dr. Albert Schweitzer to treat amoebic dysentery in Africans.[1] Protozoal infections are responsible for much of the morbidity seen in AIDS and AIDS-related complex patients. Offending organisms include Isospora, Cryptosporidia, Pneumocystis, and Toxoplasma. Currently, drugs used to

treat these infections are very toxic and may further hamper the immune system. In vivo and in vitro studies must ascertain garlic's effectiveness against these organisms.

Parasitic infections in humans, livestock, and poultry have been treated with garlic. Garlic has been used to treat Ascaris, hookworm, and tapeworm infections, and it is used to control some parasites that contaminate vegetables.[51] Further studies are needed to evaluate garlic's antiparasitic activity for human and veterinary applications. Extraintestinal Strongyloides is the most common helminthic infection in AIDS patients.

The antiviral activity of garlic has long been intimated by habitual consumers of garlic who rarely have colds or become victims of influenza epidemics. Garlic has been known to abort colds even in those who are not regular consumers. In vivo studies with mice revealed that garlic administration protected mice against intranasal inoculation with influenza viruses and enhanced the production of neutralizing antibodies when given the vaccine.[68] In vitro studies have shown that garlic has antiviral activity against Herpesvirus hominis type I and the Influenza B virus.[8] Recently, preliminary studies have revealed a significant enhancement of NK-cell activity in humans administered raw or cold-aged, whole-clove garlic preparations daily for three weeks.[70] The antiviral activity of garlic in humans may be secondary to a direct toxic effect on viruses and enhanced NK-cell activity that destroys virus-infected cells. Garlic's inhibition of lipogenesis should be evaluated in patients with HIV; altering lipid synthesis could profoundly affect its pathogenicity. A recent study revealed that an aqueous extract of garlic inhibited lipid synthesis in Candida species, and this is probably an important mechanism in helping to explain its antifungal activity.[109]

CONCLUSIONS

Profound therapeutic and economic implications will evolve as data from studies continue to confirm the medicinal spectra of garlic. Studies in the near future may suggest how much garlic we need to consume to maintain optimal functioning of the immune system as well as preventing and reversing atherosclerosis. Investing in further basic and clinical studies of this versatile medicinal herb should yield great returns.

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